STATEMENT OF WORK
20 April 2004

This request is for a non-personal services contract for an individual scientist to perform research in mathematically modeling the inverse scattering of acoustic waves and teach mathematics courses in direct support of the AFIT/ENC mission. The contractor will conduct advanced research in scattering problems, provide classroom instruction in graduate mathematics courses and review of undergraduate mathematics courses, and provide consultations with faculty and students. The contractor's work will be performed at the Air Force Institute of Technology, Graduate School of Engineering and Management, Department of Mathematics and Statistics. In particular, the contractor will do the following research and teaching:

RESEARCH: (13 Sep 04 – 9 Sep 05): Investigate ways of determining the scattered field from a scattering obstacle in order to identify the location and shape of the scatterer with the goal of improving existing techniques for nondestructive evaluation. He/she will also develop a class of fast algorithms of spectral accuracy for the solution of the Laplace equation in separable geometries, providing both theoretical justification and numerical validation of the proposed methods. The contractor will also investigate ways in which these improved techniques and algorithms can be used to solve outstanding problems of particular interest to the Air Force and Department of Defense. The contractor will give quarterly oral reports and a final written report on his/her findings to the faculty of the Department of Mathematics and Statistics. The quality of the research conducted is expected to be such that technical peers will judge the final results to be original and publishable in appropriate archival, refereed, professional journals.

TEACHING: The contractor will prepare and teach the following courses:

Mathematics Review
Last Three Weeks of Fall Short Term, 13 Sep 04 – 1 Oct 04
One section. 10 hours of lecture per week per section. Three (3) weeks of class.

MATH 509, Mathematical Methods in the Physical Sciences
Fall Quarter, 4 Oct 04 – 17 Dec 04
Two sections. 4 hours of lecture per week per section. 10 weeks of class and a final exam

MATH 513, Methods of Applied Mathematics II
Winter Quarter, 3 Jan 05 – 17 Mar 05
One section. 4 hours of lecture per week per section. 10 weeks of class and a final exam

MATH 508, Applied Numerical Methods
Spring Quarter, 28 Mar 05 – 10 Jun 05
One section. 4 hours of lecture per week per section. 10 weeks of class and a final exam

Mathematics Review
2nd Half of Summer Short Term, 13 Jun 05 – 24 Jun 05.
One section. 10 hours of lecture per week per section. Two (2) weeks of class.

MATH 676, Numerical Analysis II
Summer Quarter, 27 Jun 05 – 9 Sep 05
One section. 4 hours of lecture per week per section. 10 weeks of class and a final exam

Services Required: Services include preparation and presentation of a quarterly oral report and a final written report on the research findings; for classes taught, services include preparing class lectures, course outline, handout materials, grading papers and problem assignments, quizzes (if needed), midterm and final exams, and five hours of scheduled office consultation per week. For classes taught, quizzes, exams, problems, and class participation will be evaluated and final grades with justification will be submitted to the Head, Department of Mathematics and Statistics, by suspense date (to be determined). Classes will be taught at times as scheduled by the AFIT Registrar (AFIT/RR), or as arranged by the instructor with students with the approval of the Head, Department of Mathematics and Statistics.

Mathematics Review is a noncredit review of the fundamentals of various elementary mathematics courses to prepare the student for graduate study. Topics from elementary calculus, linear algebra, and differential equations will be covered depending on the needs of the students.

MATH 509, Mathematical Methods in the Physical Sciences, covers basic topics in linear algebra and the calculus of several variables. Topics in linear algebra include matrix algebra, solutions of systems of linear equations, real vector spaces, and linear transformations between real vector spaces. Topics from several variable calculus include partial differentiation, directional derivatives, functional transformations and Jacobians, maxima and minima, and integration in two and three variables.

MATH 513, Methods of Applied Mathematics II, is an introductory graduate level course in methods of applied mathematics. Topics covered include complex integrals, Cauchy's integral formula, orthogonal sets of functions, Laplace transforms, solution of differential equations, algebra of matrices, determinants, systems of linear algebraic equations, eigenvalues, eigenvectors, matrix methods for systems of linear differential equations, power series, Taylor and Laurent series, integration by the method of residues and the evaluation of real integrals using residue theory.

MATH 508, Applied Numerical Methods, is designed primarily to provide digital computer-oriented methods for determining roots of equations, solutions of systems of equations, approximation of functions, values of definite integrals, solutions of ordinary and partial differential equations, and matrix eigenvalue problems.

MATH 676, Numerical Analysis II, develops special techniques for solution of large systems of linear algebraic equations, generalized inverses, numerical treatment of matrix eigenvalue problems, consistency, convergence and stability of schemes for solution of ordinary and partial differential equations.

Job Tasks Summary:

RESEARCH: The contractor will develop solutions to problems of inverse scattering of acoustic waves and develop classes of fast algorithms of spectral accuracy for the solution to Laplace's equation on certain geometries. He/she will investigate ways in which these same methods can be used to solve problems of particular interest to the Air Force and Department of Defense. This will require the contractor to find the appropriate problems and demonstrate the applicability and effectiveness of the new techniques. The contractor will give quarterly oral reports and a final written report on his/her findings to the faculty of the Department of Mathematics and Statistics.

TOTAL RESEARCH HOURS	965 hours

TEACHING:

Mathematics Review (Last Three Weeks of Fall Short Term)	
Lectures (1 section at 10 hours/week/section for 3 weeks)	30 hours
Lecture preparation	60 hours
Office hours (5 hours/week for 3 weeks)	15 hours
TOTAL HOURS	105 hours
MATH 509 (Fall Quarter)	
Lectures (2 sections at 4 hours/week/section for 10 weeks)	80 hours
Lecture preparation, testing, and grading	140 hours
Office hours [5 hours/week for 10 weeks]	50 hours
TOTAL HOURS:	270 hours
MATH 513 (Winter Quarter)	
Lectures (1 section at 4 hours/week/section for 10 weeks)	40 hours
Lecture preparation, testing, and grading	120 hours
Office hours [5 hours/week for 10 weeks]	50 hours
TOTAL HOURS:	210 hours
MATH 508 (Spring Quarter)	
Lectures (1 section at 4 hours/week/section for 10 weeks)	40 hours
Lecture preparation, testing, and grading	120 hours
Office hours [5 hours/week for 10 weeks]	50 hours
TOTAL HOURS:	210 hours
Mathematics Review (2nd Half of Summer Short Term)	
Lectures (1 section at 10 hours/week/section for 2 weeks)	20 hours
Lecture preparation	40 hours
Office hours [5 hours/week for 10 weeks]	10 hours
TOTAL HOURS	70 hours
MATH 676 (Summer Quarter)	
Lectures (1 section at 4 hours/week/section for 10 weeks)	40 hours
Lecture preparation, testing, and grading	120 hours
Office hours [5 hours/week for 10 weeks]	50 hours
TOTAL HOURS:	210 hours
TOTAL INSTRUCTIONAL RELATED HOURS:	1075 hours
GRAND TOTAL HOURS (Research & Instruction)	2040 hours